Claims

1. An intravascular device for removing plasma fluid from a patient's blood, said device comprising (a) a dual lumen intravascular catheter having open and closed ends wherein the lumina are coaxially disposed as a central core channel and a circumferential outer channel within said catheter, said channel containing the inner lumen having open ends at both the near end and distal ends of the device; (b) inlet and outlet tubing ports at the near open end of the inner lumen and the open end of the outer lumen respectively, said inlet port communicating with the inner lumen for enabling a fresh hyperosmotic fluid to pass into the inner lumen and out through the distal open end of the core channel and then flow back through the circumferential outer lumen and out of the device through the outlet tubing port, which communicates with the outer lumen; (c) the outer lumen being defined by the circumferential channel of the coaxial configuration and formed between the core channel and the inner surface of the outer catheter wall comprising a semipermeable membrane and having its outer surface so positioned to directly contact whole blood passing y it; (d) said inner channel being formed from a nonpermeable polymer, so arranged as to permit a continuous supply of fresh hyperosmotic fluid to the outer lumen and thereby exert sufficient osmotic pressure to force plasma fluid from the flood, crossing from the outer to inner surfaces of the circumferential semipermeable wall, into said outer lumen and thence out the outflow port.

2. A device according to claim 1 and further comprising luer locks disposed at the ends of the inlet and outlet ports.

3. A device according to claim 2, wherein the luer lock disposed at the end of the outlet port further comprises a guide wire having a hub at one end thereof, said hub being removably secured to said luer lock.

4. A device according to claim 1, wherein the semipermeable membrane is a polymeric flexible membrane selected from the group consisting of hydrophilic polyamides, hydophilically modified fluorocarbons, polyether sulfones, siloxanes, polysiloxanes and polysulfones.

5. A device according to claim 4, wherein the semipermeable membrane is a hydrophilic polyamide having a high ultrafiltration coefficient and a molecular weight cut-off below that of the hyperosmotic fluid.

6. A device according to claim 5, wherein the hyperosmotic fluid is a dextrose solution and the molecular weight cut-off is below about 180 Daltons.

7. A device according to claim 1, wherein the nonpermeable membrane is a polyurethane, a derivative of silicone or silastic.

8. A device according to claim 7, wherein the nonpermeable membrane is a polyurethane.

9. A device according to claim 1 and further comprising a septum for separating the two lumens and maintaining structural rigidity of the catheter.

10. A device according to claim 1 and further comprising an anchor provided with a plurality of holes, said anchor being adapted to be circumferentially arranged about the device for securing the device to a tissue surface of a patient using said holes while the device is in use.

11. A device according to claim 1 and further comprising inflow and outflow pumps attached respectively to the inlet and outlet ports for regulating and controlling the flow of hyperosmotic fluid into and out of the device, and thereby also regulating the rate of plasma fluid removal from the patient's blood.

12. A device as claimed in claim 1, wherein the semipermeable membrane is porous to enable plasma removal, the size of the pores being selected depending upon whether it is desired to remove only plasma and small electrolytes or plasma and larger substances including proteins.

13. A method for removing plasma fluid from a patient in need thereof, said method comprising inserting the device as claimed in claim 1 into a selected blood vessel of a patient and introducing a hyperosmolar fluid into the inlet port of the device, causing plasma to be driven through the outer wall of the catheter by the osmotic pressure exerted by the hyperosmolar fluid and into said fluid which then flows out of the outlet port of the device.

14. A method as claimed in claim 13, wherein the blood vessel is a vein.

15. A method as claimed in claim 14, wherein the vein is a major vein.

16. A method as claimed in claim 15, wherein the vein is the internal jugular or femoral vein.

17. A method as claimed in claim 1, wherein the hyperosmolar fluid is an aqueous solution of a material selected from the group consisting of dextrose, disaccharides, oligosaccharides, starches and low molecular weight dextrans.

18. A method as claimed in claim 17, wherein the material is dextrose.

19. A method as claimed in claim 18, wherein the concentration of the dextrose solution is about 10 to 50% by weight.

20. A method as claimed in claim 13, wherein the pressure exerted by the hyperosmolar fluid flowing through the outer lumen causes distention of said outer lumen, thereby aiding in keeping the pores open.

21. A method as claimed in claim 13 and further comprising periodically reversing the flow of the hyperosmolar fluid using hydraulically driven means to debride the outer surface of the catheter and increase its longevity and performance characteristics.

22. An intravascular device for removing plasma fluid from a patient's blood, said device comprising (a) a dual lumen intravascular catheter having open and closed ends wherein the lumina are disposed in a side-by-side configuration with an inflow channel and an outflow channel within said catheter, said inflow channel having open ends at both the near end and distal ends of the device; (b) inlet and outlet tubing ports at the near open end of the inflow channel and the open end of the outflow channel respectively, said inlet port communicating with the inflow channel for enabling a fresh hyperosmotic fluid to pass into the inflow channel and out through the distal open end of the inflow channel and then flow back through

the outflow channel and out of the device through the outlet tubing port, which communictes with the outflow channel; (c) the outflow channel being defined and formed by a surface on the outer catheter wall comprising a semipermeable membrane and having its outer surface so positioned to directly contact whole blood passing by it; (d) said inflow channel being formed from a nonpermeable polymer, so arranged as to permit a continuous supply of fresh hyperosmotic fluid to the outflow channel and thereby exert sufficient osmotic pressure to force plasma fluid from the flood, crossing from the outflow channel into said outflow channel and thence out the outflow port.

23. A device according to claim 22 and further comprising luer locks disposed at the ends of the inlet and outlet ports.

24. A device according to claim 23, wherein the luer lock disposed at the end of the outlet port further comprises a guide wire having a hub at one end thereof, said hub being removably secured to said luer lock.

25. A device according to claim 22, wherein the semipermeable membrane is a polymeric flexible membrane selected from the group consisting of hydrophilic polyamides, hydophilically modified fluorocarbons, polyether sulfones, siloxanes, polysiloxanes and polysulfones.

26. A device according to claim 25, wherein the semipermeable membrane is a hydrophilic polyamide having a high ultrafiltration coefficient and a molecular weight cut-off below that of the hyperosmotic fluid

27. A device according to claim 26, wherein the hyperosmotic fluid is a dextrose solution and the molecular weight cut-off is below about 180 Daltons.

28. A device according to claim 22, wherein the nonpermeable membrane is a polyurethane, a derivative of silicone or silastic.

29. A device according to claim 28, wherein the nonpermeable membrane is a polyurethane.

30. A device according to claim 22 and further comprising a septum for separating the two channels and maintaining structural rigidity of the catheter.

31. A device according to claim 22 and further comprising an anchor provided with a plurality of holes, said anchor being adapted to be circumferentially arranged about the device for securing the device to a tissue surface of a patient using said holes while the device is in use.

32. A device according to claim 22 and further comprising inflow and outflow pumps attached respectively to the inlet and outlet ports for regulating and controlling the flow of hyperosmotic fluid into and out of the device, and thereby also regulating the rate of plasma fluid removal from the patient's blood.

33. A device as claimed in claim 22, wherein the semipermeable membrane is porous to enable plasma removal, the size of the pores being selected depending upon whether it is desired to remove only plasma and small electrolytes or plasma and larger substances including proteins.